Agassiz's Desert Tortoise
(Mojave Population)
(*Gopherus agassizii*)


Photo by Dudek.

Legal Status

State: Threatened

Federal: Threatened

Critical Habitat: Critical habitat was designated for the Beaver Dam Slope (Utah) population in 1980 (FR 45 55654–55666). Critical habitat for the Mojave population was designated in 1994 (FR 59 5820–5886). See Figure 3 for the location of critical habitat.

Recovery Planning: The original recovery plan for the Mojave population was completed in 1994 (USFWS 1994). A revised draft recovery plan was completed in 2008 (USFWS 2008), and a final revised recovery plan was released in 2011 (USFWS 2011a).

Taxonomy

The generic assignment of the desert tortoise has gone through a series of changes since its original description by Cooper (1863) as *Xerobates agassizii*. Currently, the accepted scientific name is *Gopherus agassizii* (Crumly 1994). Other tortoise species known to be extant in North America, all belonging to the genus *Gopherus*, include Texas tortoise (*G. berlandieri*) that occurs in southern Texas and northeastern Mexico, and the gopher tortoise (*G. polyphemus*) that occurs in southwestern South Carolina, Florida, Georgia, Alabama, Mississippi, Louisiana, and extreme southeastern Texas. The Mexican species is the Bolson tortoise (*G. flavomarginatus*), which occurs in a very small area in Chihuahua and Durango, Mexico (Bury and Germano 1994; USFWS 2011a). Fossils of late Pleistocene *G. agassizii* have been found in the area of McKittrick, California (Miller 1942), with other specimens found as far east as southeastern New Mexico (Moodie and Van Devender 1979).

A recent taxonomic review has formally split the previous single desert tortoise species into two distinct species—Agassiz's (Mojave population) desert tortoise (*Gopherus agassizii*) and Morafka's (Sonoran population) desert tortoise (*G. morafkai*) (Murphy et al. 2011). Agassiz's desert tortoise occurs in southeastern California, southern Nevada, southwestern Utah, and northwestern Arizona. Morafka's desert tortoise occurs in southwestern Arizona and south into Mexico. This genetic study, utilizing mitochondrial DNA, supports long-time observations by desert tortoise biologists that there are distinct differences in ecology, behavior, and life history between tortoises found west and north of the Colorado River, and those found to the south and east.

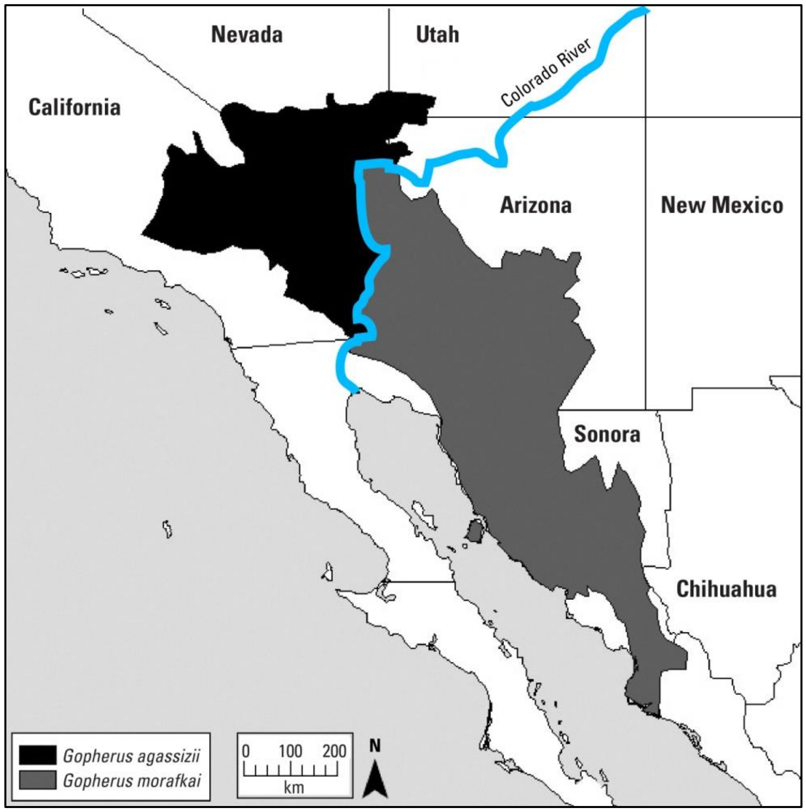
Although there are genetic and ecological differences between desert tortoises that belong to the Sonoran population, animals attributed to this population could be confused visually with individuals of the Mojave population. Because the visual differences between these populations are minor, the U.S. Fish and Wildlife Service (USFWS) determined at the time of federal listing that the Sonoran population also warranted protection as a threatened species under Section 4(e) of the Endangered Species Act (similarity of appearance) when located outside of its natural range (USFWS 2011a; see also Averill-Murray 2011).The recent taxonomic treatment of the desert tortoise to two distinct species does not affect the listing status of Agassiz's desert tortoise throughout its range.

Distribution

General

The Agassiz's desert tortoise is associated with the Sonoran (Colorado phase) and Mojave Deserts in the southwestern United States (Figure 1). Generally, its range extends north and west from the Colorado River. It extends from the desert areas of California south of the San Joaquin Valley, eastward across the Mojave Desert into southern Nevada, the extreme southwestern corner of Utah (i.e., the Beaver Dam Slope), and the extreme northwestern corner of Arizona, as well as southeast across the Colorado Desert to the Colorado River. The Desert Renewable Energy Conservation Plan (DRECP) Area supports individuals attributed to Agassiz's desert tortoise, or the Mojave population, as shown in Figure SP-R4.

Figure 1. Distribution of Agassiz's desert tortoise and Morafka's desert tortoise (Murphy et al. 2011, contained in USGS 2011).



Distribution and Occurrences within the Plan Area

Historical

The historical distribution of the desert tortoise (including both the currently recognized Agassiz's and Morafka's desert tortoise species) appears to be mostly the same as today. However, some authors indicate its range may once have been broader at the end of the Pleistocene, extending as far east as Texas and to coastal Southern California in the west. It is hypothesized that its range contracted to its current size about 8,000 years ago (Moodie and Van Devender 1979; Van Devender and Moodie 1977). Native Americans used the tortoise for a variety of purposes, including food, ceremonial uses, medicinal uses, household (utensil) uses; it also figured prominently in Native American mythology and symbolism (Schneider and Everson 1989). There are 33 historical (i.e., before 1990) occurrence records in the Plan Area (Dudek 2013) (Figure SP-R4).

Recent

Although in areas of extreme dryness its numbers are much reduced, the Agassiz's desert tortoise (hereafter tortoise or desert tortoise) is found throughout the DRECP Plan Area. For instance, the tortoise is mostly absent from the valley floor of the very hot, dry Coachella Valley, including the valley west of the Plan Area, but instead can be found on the lower slopes of the surrounding desert mountains (Coachella Valley Conservation Commission 2007). Additionally, some studies indicate that the tortoise may utilize available local habitat in a non-random fashion, perhaps focusing its activities in high plant diversity and low sand abundance areas (Baxter 1988; Duda et al. 2002; Wilson and Stager 1992). There are 1,642 recent (i.e., since 1990) occurrence records the Plan Area (Figure SP-R4) (Dudek 2013).

Natural History

Habitat Requirements

The desert tortoise can be found in a wide variety of habitats, such as alluvial fans, washes, canyons, and saltbush plains (Coachella Valley Conservation Commission 2007; Woodbury and Hardy 1948; Lovich and Daniels 2000; USFWS 1994) (Table 1). Whereas most tortoises in the Mojave Desert are usually associated with creosote bush (*Larrea tridentata*) scrub on alluvial fans and bajadas (USFWS 2011a), they can also be found in saltbush scrub (*Atriplex* spp.) (Stewart 1991) and even in some man-made structures, such as artillery mounds (Baxter 1988). Individuals in the Sonoran Desert are associated more with the low rocky slopes of the desert mountains (Schamberger and Turner 1986, Barrett 1990).

The presence of shrubs in tortoise habitat is extremely important. Shrubs not only supply shade for the tortoises during hot weather (Marlow 1979), but also their roots provide support and protection for tortoise burrows. For instance, near Twentynine Palms, California, 71% of desert tortoise burrows were associated with creosote bush, and desert tortoises avoided the only community without creosote bush (Baxter 1988). However, other investigators found that burrows were not significantly closer to creosote bush than random sites in areas with vegetation representing both Mojave and Sonoran affinities. Burrows were significantly farther from yucca (*Yucca* spp.) than random sites (Lovich and Daniels 2000). In still another case, burrows were associated with Mojave yucca (*Yucca schidigera*) and catclaw acacia (*Acacia greggii*) even though these species were not particularly abundant (Burge 1978). Wilson et al. (1999) found that most juvenile burrows were associated with shrubs. These studies point out that utilization of shrubs varies with the location of the study site; nevertheless, shrubs provide important resources for the desert tortoise.

Several studies have also shown that edaphic (soil) conditions are important for desert tortoises. Tortoises spend up to 98% of their lives underground (Nagy and Medica 1986). Where soils are so sandy that they cannot support the roof of a burrow, tortoises are unlikely to utilize the area (Baxter 1988). In a multivariate analysis of tortoise abundance criteria, Weinstein et al. (1986) indicated that "soil digability" is a significant regression variable (i.e., this variable accounted for a significant amount of the variance in habitat use). Conversely, if a caliche horizon (a hardened deposit of calcium carbonate) is present, it may be so hard that tortoises cannot successfully burrow under it. For instance, at the Twentynine Palms Marine base, Baxter (1988) found that every "tank pit" supported tortoise burrows, most often located just under the hardpan.

Table 1. Habitat Characteristics of the Desert Tortoise within the Southwest (adapted and abridged from Germano et al. 1994)

Habitat Features	Western Mojave Desert	Eastern Mojave Desert	Sonoran Desert (Morafka's desert tortoise)
Occupied Habitat	Valleys, bajadas, hills	Valleys, bajadas, hills	Bajadas, rocky slopes
Substrate	Sandy loams to rocky	Sandy loams to rocky	Rocky
Vegetation	Low-growing sclerophyll shrubs	Low-growing sclerophyll shrubs	Low-growing to arborescent sclerophyll shrubs
Annual Plants	Mostly winter germinating	Mostly fall germinating, some summer germinating	Mostly summer-germinating

Foraging Requirements

Tortoises are herbivores; wildflowers, grasses, and in some cases, cacti make up the bulk of their diet (USFWS 2010; Woodbury and Hardy 1948). Some of the more common herbaceous species utilized by the tortoise include desert dandelion (*Malacothrix glabrata*), primrose (*Oenothera* spp.), gilia (*Gilia* spp.), desert marigold (*Baileya multiradiata*), and filaree (*Erodium* spp.). Additionally, tortoises may eat some grasses, such as Indian rice grass (*Oryzopsis hymenoides*) or galleta grass (*Hilaria rigida*), although the nutritional value may be less. Also, tortoises are known to eat some cacti such as prickly pear (*Opuntia mohavensis*), beavertail (*Opuntia basilaris*), and various cholla cacti (*Opuntia* spp.). Spring desert annuals and grasses are particularly important in that they supply tortoises with much needed water (USFWS 2010), which can be stored by the tortoises for long periods of time (Marlow 1979; Woodbury and Hardy 1948). In Twentynine Palms, California, desert tortoises were found in plant communities with high plant species diversity, such as washes and ecotones between communities (Baxter 1988). Although tortoises were captured more frequently in the diverse wash community—significantly more than expected based on a random distribution—this could be a result of higher visibility to the surveyors in these areas. Nevertheless, their burrows were also significantly closer to ecotones than a set of random points. The use of these high plant diversity areas may therefore be related to increased food availability or possibly the nature of the annual herbs found in these areas.

Reproduction

The desert tortoise breeds in the late summer and fall, before going into hibernation for the winter. Males will "joust" to establish loosely defined home ranges, but these can overlap and are not exclusive. Home range size can vary dramatically, from 10 to over 450 acres (USFWS 1994). Females begin breeding at about 15 to 20 years of age, and will store the male's sperm (Gist and Fisher 1993; Turner and Berry 1984). Egg laying occurs in the spring, but occasionally may also take place in the fall. Incubation is typically about 100 days, with the eggs hatching in the late summer and early fall. There is little or no parental care of the nest or the young. The sex of the offspring is determined by the incubation temperature; females being hatched at higher ground temperatures (above 89°F) while males are hatched below this temperature (Spotila et al. 1994). Average clutch size is 4.5 eggs (Turner et al. 1984, 1986).

Spatial Behavior

Tortoise activity is focused on its home range, and is primarily determined by temperature (USFWS 1994). Nevertheless, some relocated tortoises have moved significant distances from their release point, including crossing major highways (Stewart 1991). Duda et al. (1999) found that tortoise home ranges tend to shrink during periods of drought compared to years of high rains. Following winter hibernation, tortoises become active as low temperatures abate in the spring months. During the spring, tortoises are active throughout the day, foraging on the fresh shoots of annual plants. But as the heat continues to increase into the summer months, tortoises are active only in the cooler morning, late afternoon, and evening hours. During the hot daytime temperatures, tortoises retreat to burrows to wait it out or, in some cases, will aestivate through the summer.

Ecological Relationships

The desert tortoise is a primary consumer; that is, they feed on plants. As such, they compete for vegetation resources with other primary consumers, such as the desert iguana (*Dipsosaurus dorsalis*), Gambel's quail (*Callipepla gambelii*), mourning dove (*Zenaida macroura*), pronghorn antelope (*Antilocapra americana*), and domestic cattle (*Bos taurus*). Adult tortoises are preyed on by few other animals; however, some may be taken by coyote (*Canis latrans*) and kit fox (*Vulpes macrotis*). Young tortoises are routinely preyed upon by kit fox and common raven (*Corvus corax*).

Desert tortoise burrows supply important shade and thermoregulatory resources for a variety of species, including many species of snakes, insects and spiders, and small mammals.

Population Status and Trends

Global: Declining (USFWS 2011a; Corn 1994; Bury and Corn 1995; Berry and Medica 1995; Woodman 2004)

S**tate:** Same as above
Within Plan Area: Same as above

According to the Revised Recovery Plan for the Mojave Population of the Desert Tortoise (*Gopherus agassizii*), the Mojave population occurs north and west of the Colorado River in the Mojave Desert of California, Nevada, Arizona, southwestern Utah, and the Colorado Desert in California (USFWS 2011a). Historic information for the Mojave population densities or abundance does not exist to provide a baseline for population trends (USFWS 2011a). Long-term study plots and other studies, however, suggest "appreciable declines" at the local level in many areas, and that the identified downward trend of the species in the western portion of the range at the time of the federal listing as threatened in 1990 was valid and is ongoing (USFWS 2011a). Results of studies in other parts of the Mojave population's range also are inconclusive, but suggest that declines are broadly distributed across the tortoise's Mojave Desert range (USFWS 2011a). In addition, specific management actions over a 23-year monitoring program have not demonstrated a positive effect on populations, although the life history of the species (i.e., delayed reproductive maturity, low reproductive rates, and relatively high mortality early in life) is such that rapid increases in populations are unlikely to be observed (USFWS 2011a).

Threats and Environmental Stressors

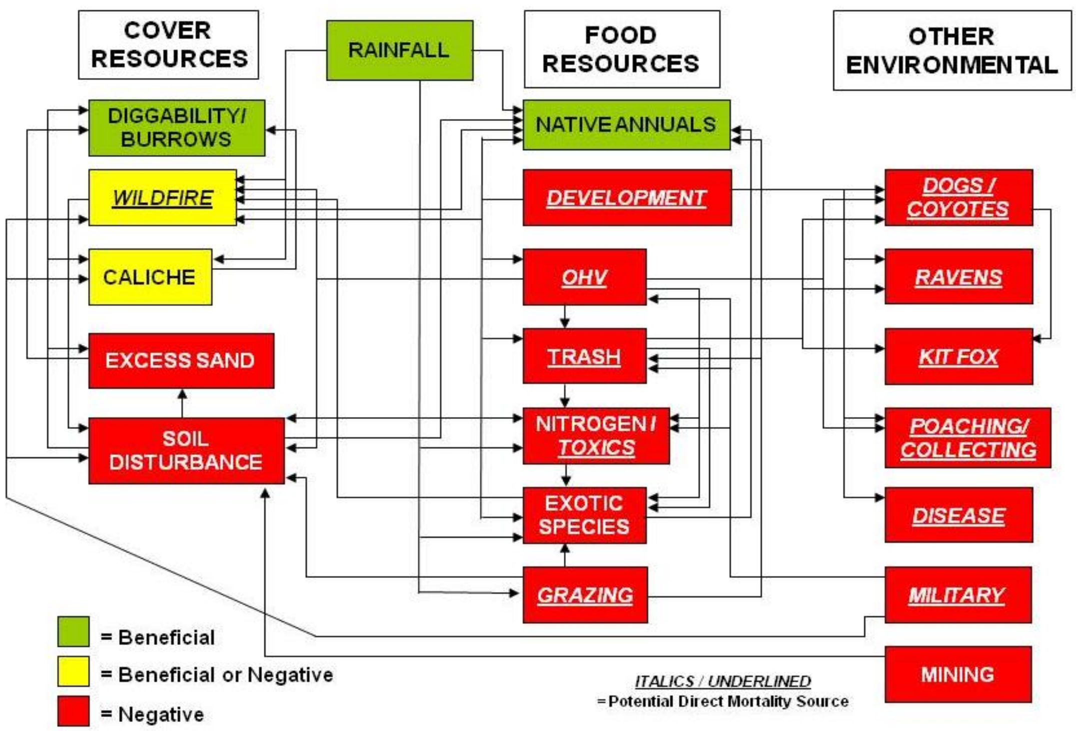
The desert tortoise is faced with a multitude of threats and environmental stressors to its survival. Many of these threats are synergistic (Tracy et al. 2004). Figure 2 presents a generalized conceptual model of some of the more important threats and stressors to the desert tortoise. For a detailed review of these threats and stressors, please see USFWS (2011a) and Boarman (2002). Chief among these threats are:

- Predation;
- Habitat loss and fragmentation;
- Disease;
- Other human activities (e.g., agriculture, fire, landfills, grazing, military activities);

- Off-highway vehicle (OHV) use;
- Collecting; and
- Invasive species.

Figure 2. Example of a generalized conceptual model of tortoise threats and stressors.

Predation: The desert tortoise is subject to predation from several



feral dog (*Canis familiaris*) (Evans 2001), coyote, and kit fox (Bjurlin and Bissonette 2001), although the precise magnitude of impacts remain unclear (Turner et al. 1987). However, the majority of predation occurs on incubating eggs and young tortoises whose shells are still soft. In addition, predation of the young by the common raven is becoming increasingly important (Campbell 1985; Berry 1985; Boarman 1993; Kristan and Boarman 2003). Although a "natural predator," raven populations in the Mojave Desert increased by 1,000% between 1968 and 1992. This increase is sometimes attributed to the increase in landfills (Engel and Young 1992), but it could also be related to the increase in roads, providing roadkill for this highly opportunistic species (Boarman 1993; Boarman and Berry

1995). Increased predation by coyotes has been shown to be a major factor affecting the success of a large-scale relocation of desert tortoises at Fort Irwin (Berry et al. 2011).

Habitat Loss and Fragmentation: Habitat loss and fragmentation are often considered one of the most important factors in reducing tortoise numbers (U.S. Bureau of Reclamation 2008; USFWS 1994; Berry and Burge 1984). Residential and infrastructure development, as well as infrastructure improvements, have the effect of directly reducing available tortoise habitat, but also introduce a number of indirect effects, such as attractants to ravens and coyotes and invasive plant species. Further development and associated roads act as barriers to tortoise movement (as well as sources of direct mortality) that fragment populations into smaller subpopulations. Generally speaking, models have shown that populations of species that are physically isolated are more likely to be extirpated by stochastic, demographic, and/or genetic consequences (Gilpin and Soulé 1986.)

Disease: Major threats to the continued existence of the desert tortoise come from several diseases (Jacobson 1994). Principal among these are upper respiratory tract disease caused by the bacteria, *Mycoplasma agassizii* and *M. testudineum* (Berry 1997; Brown et al. 1999; USFWS 2011a), and cutaneous dyskeratosis, a shell disease (Jacobson et al. 1994; Homer et al. 1998). It is often thought that these diseases were introduced into native populations by the release of infected pets back into the wild (Boarman 2003; Coachella Valley Conservation Commission 2007; USFWS 2011a; Johnson et al. 2006). From 1979 to 1992, the population of tortoises at the Desert Tortoise Natural Area, near Mojave, California, decreased by 76% (Berry 1997; Hardenbrook and Tomlinson 1991), with the last 5 years attributed to disease.

OHV Use: For decades, the use of OHVs in the desert has continued to increase in frequency. This use includes a wide spectrum of activities, ranging from occasional personal use for access, to other activities (e.g., camping, rock hounding, photography, research), to large organized competitive events. In addition to direct mortality by crushing, the list of potential impacts from OHV use is great; it includes destruction and degradation of vegetation (forage), soil compaction, and the destruction of cryptogamic soils, but also facilitation of erosion (Adams et al. 1982; Berry 1990; Berry et al.

1994; Bury and Luckenbach 1986; Davidson and Fox 1974; Vollmer et al. 1976). With the increase in backcountry visitation, other indirect impacts can increase, such as the introduction of invasive plants, increased trash dumping (which can attract common ravens, coyotes, and feral and pet dogs), increased fires, and the introduction of pets (USFWS 1994).

Collecting: Desert tortoises are often collected as pets. Stubbs (1991) discusses the general aspects and causes of human collecting of wildlife. Data for this phenomenon are mostly anecdotal; however, Stewart (1991) documented the removal and possible killing of tortoises that were radio-collared (see also Berry 1990). As mentioned previously, re-release of captured tortoise back into the wild is often cited the source of introduction of disease into native populations (USFWS 1994). This release of pet tortoises can also result in the increase in competition for scarce resources with resident native tortoises, as well as possibly serving as a source of genetic contamination. It remains unclear as to the magnitude of this threat (Boarman 2002).

Invasive Species: The Plan Area has been subject to invasion by numerous invasive plant species (Brooks 1998; Boarman 2002). Principal among these are non-native annual grasses (e.g., *Bromus* spp., *Schismus* spp.), tamarisk, and, more recently, invasive Sahara mustard (*Brassica tournefortii*). Although these introduced species may serve as some forage for tortoises, their nutritional value is likely less than native species. These species colonize rapidly following fires or other ground disturbances (Brown and Minnich 1986; Davidson and Fox 1974; Hobbs 1989), competing against native annuals and perennial seedlings for the sparse resources, as well as in some cases, preventing movement of some species. In some areas, native vegetation has been replaced by essentially monospecific stands of these invaders (see Brooks 1998, 2000).

Other Human Activities: Numerous other human activities affect desert tortoise, many of which are interrelated. Agriculture affects desert tortoises through conversion of habitat into mostly unsuitable uses (Boarman 2002, 2003) and can introduce invasive species and toxins into the environment. Fire can impact tortoises through direct mortality (Homer et al. 1998) but also by the type-conversion of native habitat to non-native grasslands and weedy forbs. These grasses and forbs can, in turn, increase flashy fuel loads and fire frequency, exacerbating and increasing the frequency of the problem (Esque et al. 1994; Jacobson 1994). Landfills have the direct effect of usurping sometimes large areas of available habitat, but their primary impact to tortoises results from an increase in the number of predators (coyotes, common ravens, feral dogs) they can attract (Boarman 1993, 2003; Engle and Young 1992). Grazing can reduce forage available to desert tortoises (Nicholson and Humphreys 1981; USFWS 1994), as well as occasionally killing them outright or destroying nests by trampling (Jacobson 1994). Grazing can also increase the presence of non-native invasive species (Brooks 1998). However, quantitative data on the actual direct impacts of grazing, both cattle and sheep, are generally lacking (Boarman 2002). Military activities can result in direct mortality of tortoises by crushing (Baxter and Stewart 1990; Stewart and Baxter 1987), as well as the loss and degradation of habitat and the collapse of burrows and nests (USFWS 1994).

Conservation and Management Activities

Following the listing of the desert tortoise, the Desert Tortoise Management Oversight Group (Oversight Group) was established in 1988. The initial purpose of the Oversight Group was to coordinate agency management and planning, and to begin implementation of management strategies on (primarily) Bureau of Land Management (BLM) land (USFWS 2011a). In addition to BLM staff, USFWS staff was initially included, but the Oversight Group was later expanded to include representatives from the Department of Defense, U.S. Geological Survey, and the National Park Service. The purpose of the Oversight Group was to serve as a clearinghouse of the various agencies' tortoise management plans and implementation, identify data gaps and threats, and provide review of ongoing research into the desert tortoise (USFWS 2011a).

In 2003, USFWS, following recommendations of a General Accounting Office (GAO) report (GAO 2002), created the Desert Tortoise Recovery Plan Assessment Committee, which was empowered to review the successes and failures of the initial 1994 recovery plan. This report was completed in 2004 (Tracy et al. 2004). Generally the report found that the recovery plan of 1994 was serving its function, but that the plan needed to be revised based upon new knowledge of desert tortoise biology, ecology, genetics, the previously unappreciated synergistic nature of the multiple threats, and advances in scientific techniques, which had been elucidated over the previous decade. The report also echoed the conclusion of the GAO report that called for a concerted, coordinated effort by the various agencies, especially in the identification and interpretation of basic desert tortoise research. To this end, USFWS established the Desert Tortoise Recovery Office (DTRO) in 2004. Since that time, the DTRO has served as the principal clearinghouse for research and monitoring of the desert tortoise north and west of the Colorado River (USFWS 2011a). It also coordinates activities of the Oversight Group, and [later] the Desert Manager's Group, as well as other agencies and scientists working on the tortoise (USFWS 2011a). The DTRO also established a desert tortoise science advisory committee in 2005 to provide scientific advice on recovery tasks, ensuring a sound scientific basis for their results and conclusions.

In 1995, the Desert Manager's Group was established as the forum for government agencies to address and discuss issues of common concern. Not just focused on the desert tortoise, the Desert Manager's Group seeks to provide a forum for cooperative management that provides "… greater operational efficiency, enhances resource protection, and the public is better served" (Desert Manager's Group 2005), but nonetheless has produced a 5-year plan related to several tortoise issues (USFWS 2011a).

Based on recommendations in the recovery plan assessment (Tracy et al. 2004), the goals of management for the desert tortoise are:

- Maintain self-sustaining populations of desert tortoises within each recovery unit into the future;
- Maintain well-distributed populations of desert tortoises throughout each recovery unit; and
- Ensure that habitat within each recovery unit is protected and managed to support long-term viability of desert tortoise populations.

The revised recovery plan (USFWS 2011a) calls for a revision of the existing recovery plan (USFWS 1994) with the following goals:

1. Develop, support, and build partnerships to facilitate recovery: The revised recovery plan proposes to establish recovery implementation teams to coordinate and evaluate management and monitoring at a recovery unit level. The recovery implementation teams will also be charged with providing education and outreach activities. Protect existing populations and habitat, instituting habitat restoration where necessary: The revised recovery program calls for increased protection of desert tortoises within "tortoise conservation areas" defined as, "… desert tortoise habitat within critical habitat, desert wildlife management areas, areas of critical environmental concern, Grand Canyon–Parashant National Monument, Desert National Wildlife Range, National Park Service lands, Red Cliffs Desert Reserve, and other conservation areas or easements managed for desert tortoises," or areas further identified by the individual recovery implementation teams. The plan also indicates the importance of recognizing that areas outside the conservation areas may affect what happens within them and recommends a broader outlook toward implementation through interagency cooperation and coordination.

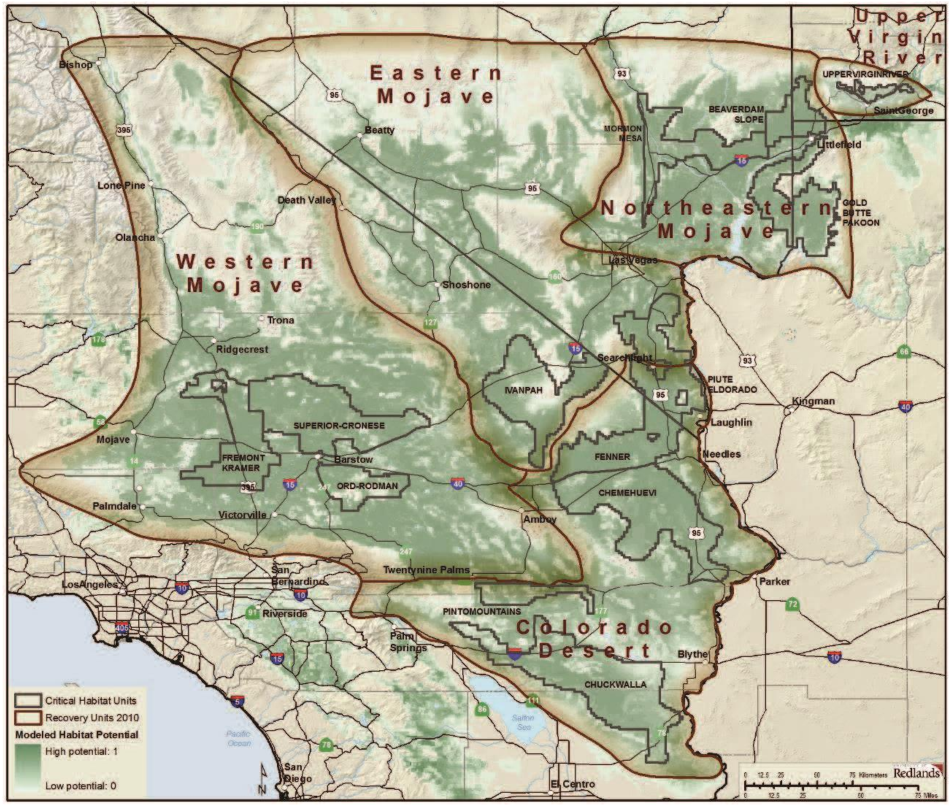
2. Augment depleted populations in a strategic manner: The revised recovery plan calls for the augmentation of depleted or extirpated populations of the desert tortoise. This augmentation should be completed as an adaptive management strategy, focusing its implementation on answering not only important questions regarding the success of relocation techniques, but also those of understanding threats and stressors.

3. Monitor progress toward recovery: A new approach toward monitoring is proposed that not only assesses the status of desert tortoise populations (at 5-year intervals), but also includes multidimensional monitoring of such variables as threats, habitat quality, and changes that could be related to climate change. Monitoring will focus on those metrics directly related to recovery criteria.

4. Conduct applied research and modeling in support of recovery efforts within a strategic framework: Similar to No. 4 (above), the revised plan indicates a need to fill data gaps in tortoise biology and ecology through applied adaptive research activities. In particular, the plan identifies the need to investigate the synergistic nature of human threats to the tortoise, how they interrelate, and how these in turn affect tortoise abundance.
5. Implement a formal adaptive management program: Based on conceptual models (see Figure 2 as an example), and using data gathered from the implementation of the above programs, the revised recovery plan calls for the formal structuring of an adaptive management program, coordinated through the DTRO, to integrate the results of the various adaptive management experiments.

The revised recovery plan also calls for a revision of the desert tortoise recovery units. Based on recent genetic work (Murphy et al. 2007; Hagerty and Tracy 2007), it is proposed to redefine the units from an initial six to five units. The principal changes are results of combining and expanding the previous northern Colorado and eastern Colorado units into one (i.e., Colorado Recovery Unit, Figure 4), a contraction of the Eastern Mojave Recovery Unit, an appurtenant expansion of the Northeastern Recovery Unit, and a contraction of the southern extreme of the Western Mohave Recovery Unit in the vicinity of the Coachella Valley. Figure 3 shows the revised recovery units.

Figure 3. Revised recovery units from draft revised recovery plan (USFWS 2011a).



Data Characterization

The desert tortoise has supported a long history of research. Since 1976, many of these data and results have been presented annually at the yearly symposium of the Desert Tortoise Council (Beaumont, California). Papers have addressed virtually every aspect of desert tortoise ecology, physiology, and behavior. In spite of the plethora of reports, USFWS (2008) states, "However, despite clear demonstration that these threats impact individual tortoises, there are few data available to evaluate or quantify the effects of threats on desert tortoise populations. While current research results can lead to predictions about how local tortoise abundance should be affected by the presence of threats, quantitative estimates of the magnitude of these threats, or of their relative importance, have not yet been developed. Thus, a particular threat or subset of threats with discernible solutions that could be targeted to the exclusion of other threats has not been identified for the desert tortoise."

Management and Monitoring Considerations

Although specific management of the desert tortoise in the Plan Area will likely be site-specific (e.g., fencing locations, patrol routes, artificial burrow locations), particularly as each site relates to anthropocentric activities either on the site or nearby, generally, overall management should include the following activities, all of which should be coordinated with the USFWS Desert Tortoise Recovery Office and the respective recovery implementation team:

- Establishment of a series of occupied preserves of native tortoise (and other species) habitat using the best currently understood principles of conservation biology, such as, but not limited to, connectivity and movement corridors, distinct genetic varieties, and reserve size.
- Creation of educational programs to inform the public about the tortoise, other desert species, and desert ecosystems; in particular, supply of information regarding the dangers of releasing pet tortoises back into the wild and the effects of trash dumping and OHV activities.
- Creation of enforcement programs to ensure the integrity of the preserve system to minimize levels of threats and stressors.
- Funding of continued research into the precise nature and effects of threats and stressors of the desert tortoise. This offers the best avenue for long-term management by furthering understanding of the ecological relationships of the tortoise, thereby making management decisions more focused and efficacious.
- Establishment of ongoing adaptive management programs to elucidate the effects of threats and stressors of the desert tortoise.
- Establishment of a repository for captured or sick tortoises to help prevent their release into the wild.

Species Modeled Habitat Distribution

This section provides the results of habitat modeling for Agassiz's desert tortoise, using available spatial information and occurrence information, as appropriate. For this reason, the term "modeled suitable habitat" is used in this section to distinguish modeled habitat from the habitat information provided in Habitat Requirements, which may include additional habitat and/or microhabitat factors that are important for species occupation, but for which information is not available for habitat modeling.

There are 12,642,923 acres of modeled suitable habitat for desert tortoise in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

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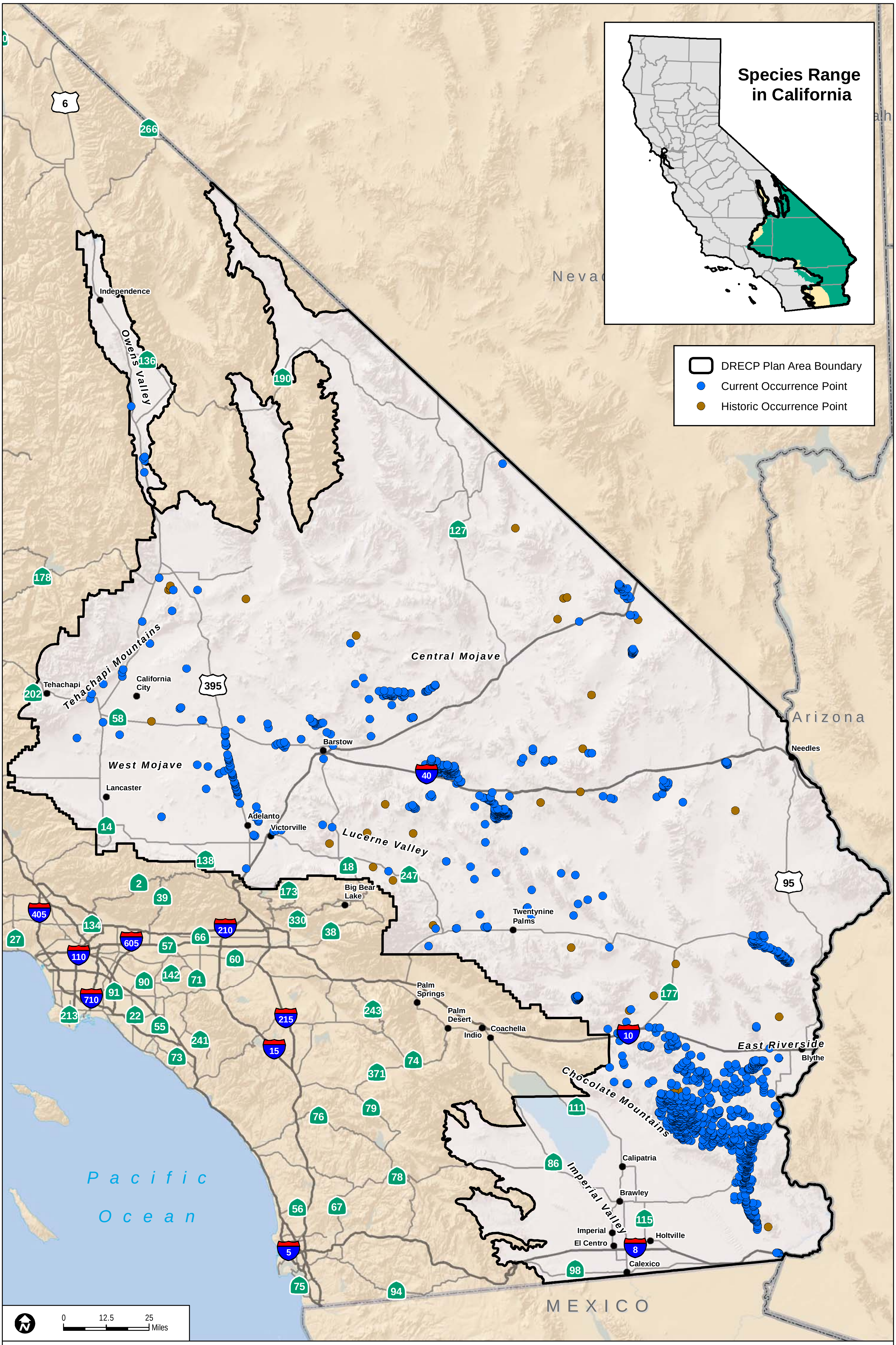

Sources: ESRI (2014); DRECP Species Occurrence Database (2013), CWHR (2008)

FIGURE SP-R01

Desert Tortoise Occurrences in the Plan Area